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Lee

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(54) **ELECTRICAL CONNECTOR ASSEMBLY HAVING GROUNDING BUSES**

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(22) Filed: **Sep. 5, 2000**

(51) **Int. Cl.**[7] **H01R 13/648**
(52) **U.S. Cl.** **439/108**; 439/608
(58) **Field of Search** 439/108, 101, 439/74, 947, 607, 608

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,618,191 * 4/1997 Chikano et al. 439/108
5,904,581 * 5/1999 Pope et al. 439/74

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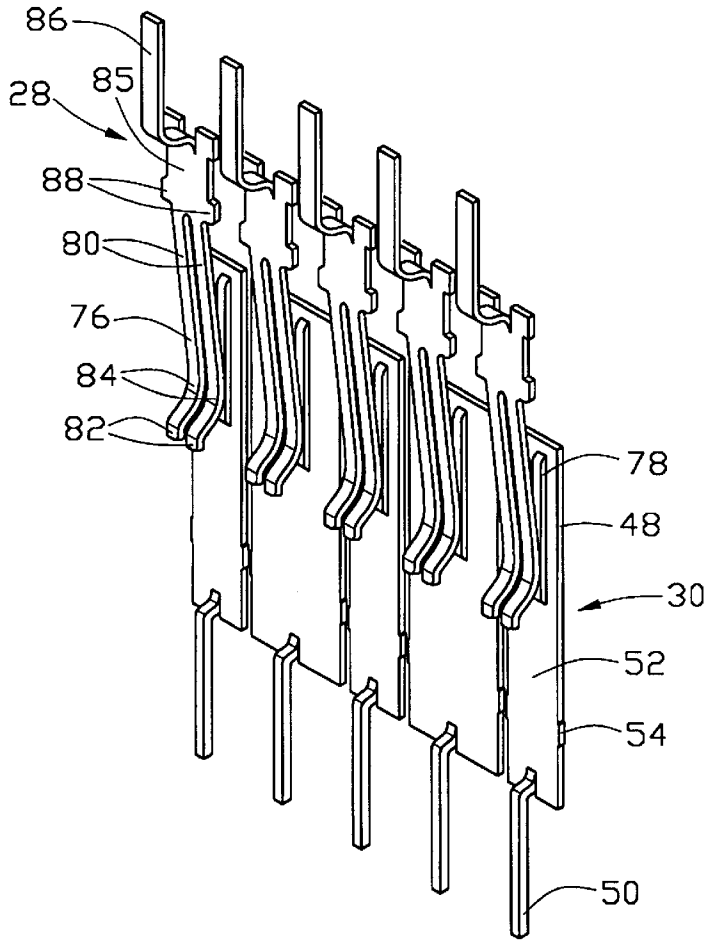
(57) **ABSTRACT**

An electrical connector assembly includes a receptacle connector and a mating plug connector. The receptacle connector has an insulative housing forming two elongate sidewalls mounting a plurality of signal terminals therein. An internal wall defining a plurality of grooves for receiving a plurality of first ground buses therein is formed at the center of the insulative housing. The plug connector has a dielectric housing with a base and two rows of tongues extending upward from the base. A plurality of passageways is defined in an outer side surface of each tongue with signal contacts received therein for electrically connecting with the signal terminals of the receptacle connector. A plurality of grooves is defined in an inner side surface of each tongue with a plurality of second ground buses received therein for engaging with the first ground buses of the receptacle connector.

14 Claims, 12 Drawing Sheets



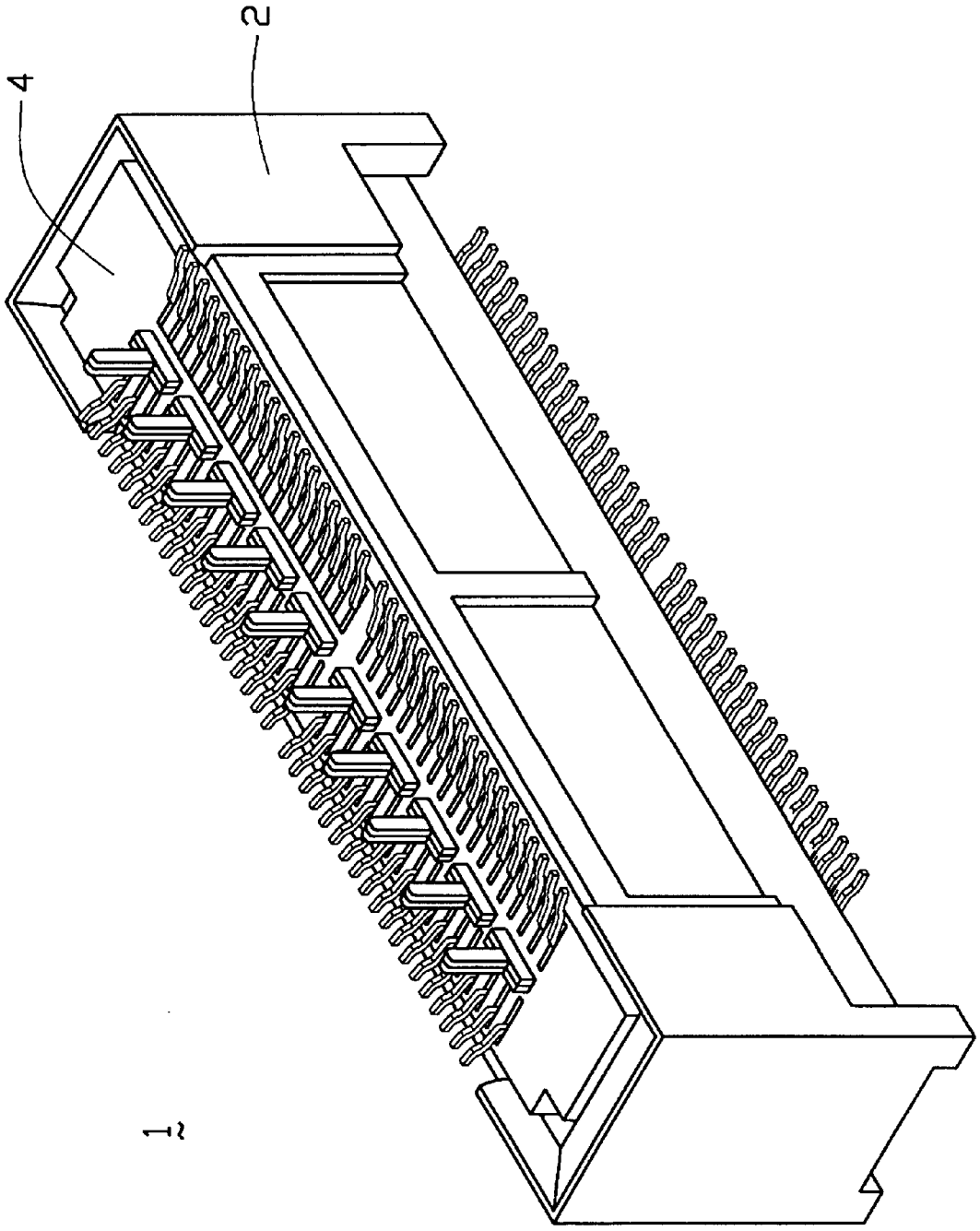


FIG. 1

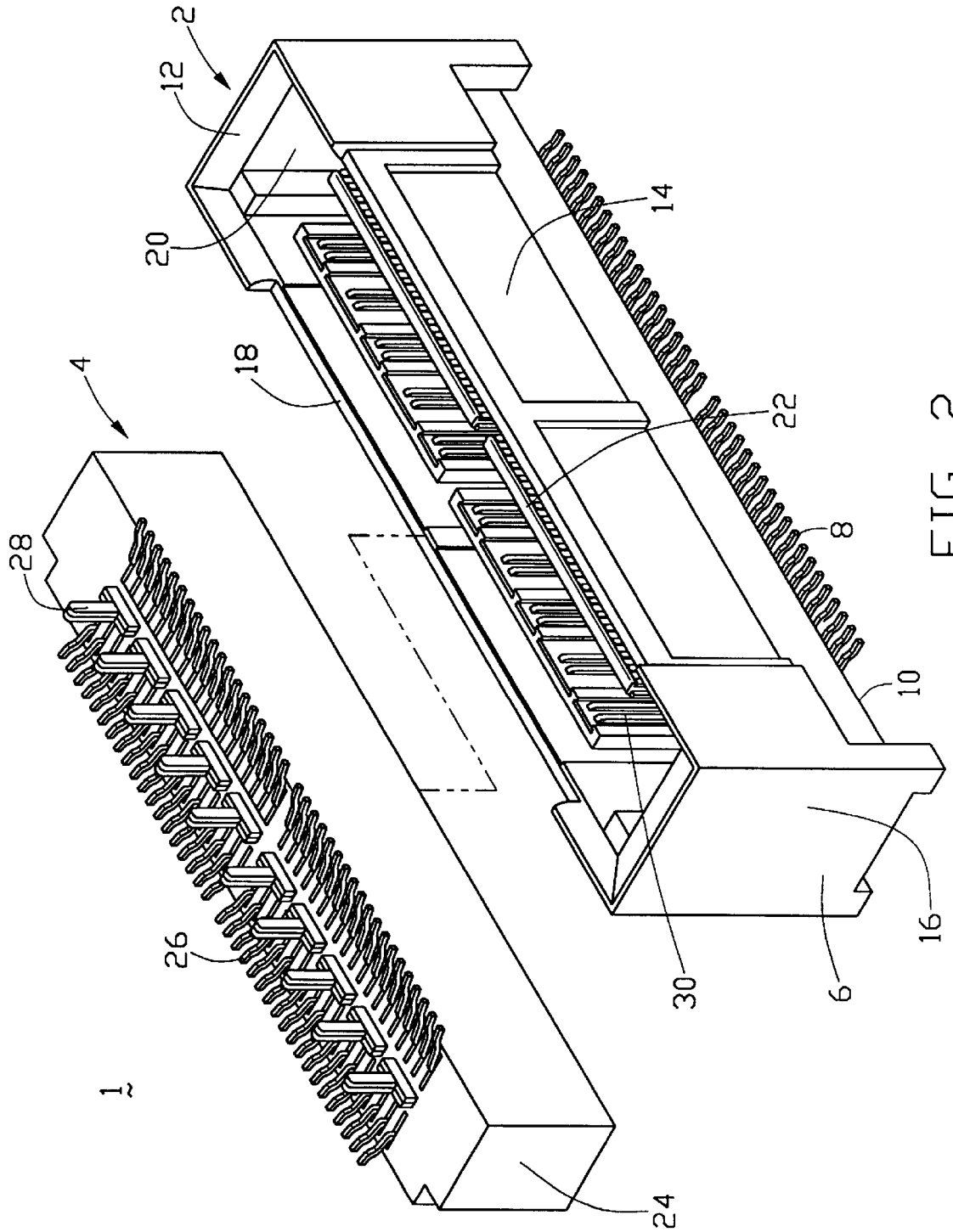


FIG. 2

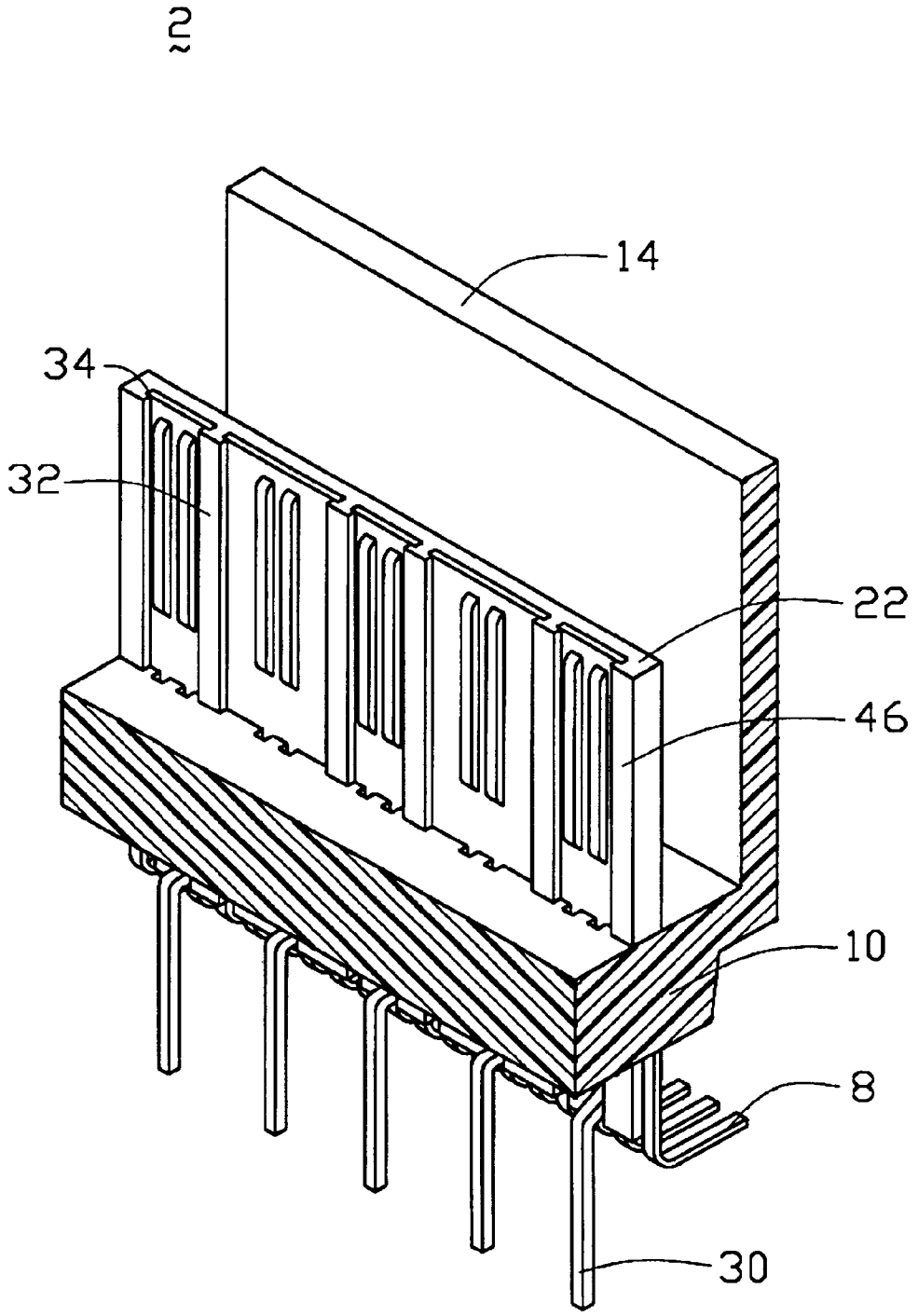


FIG. 3

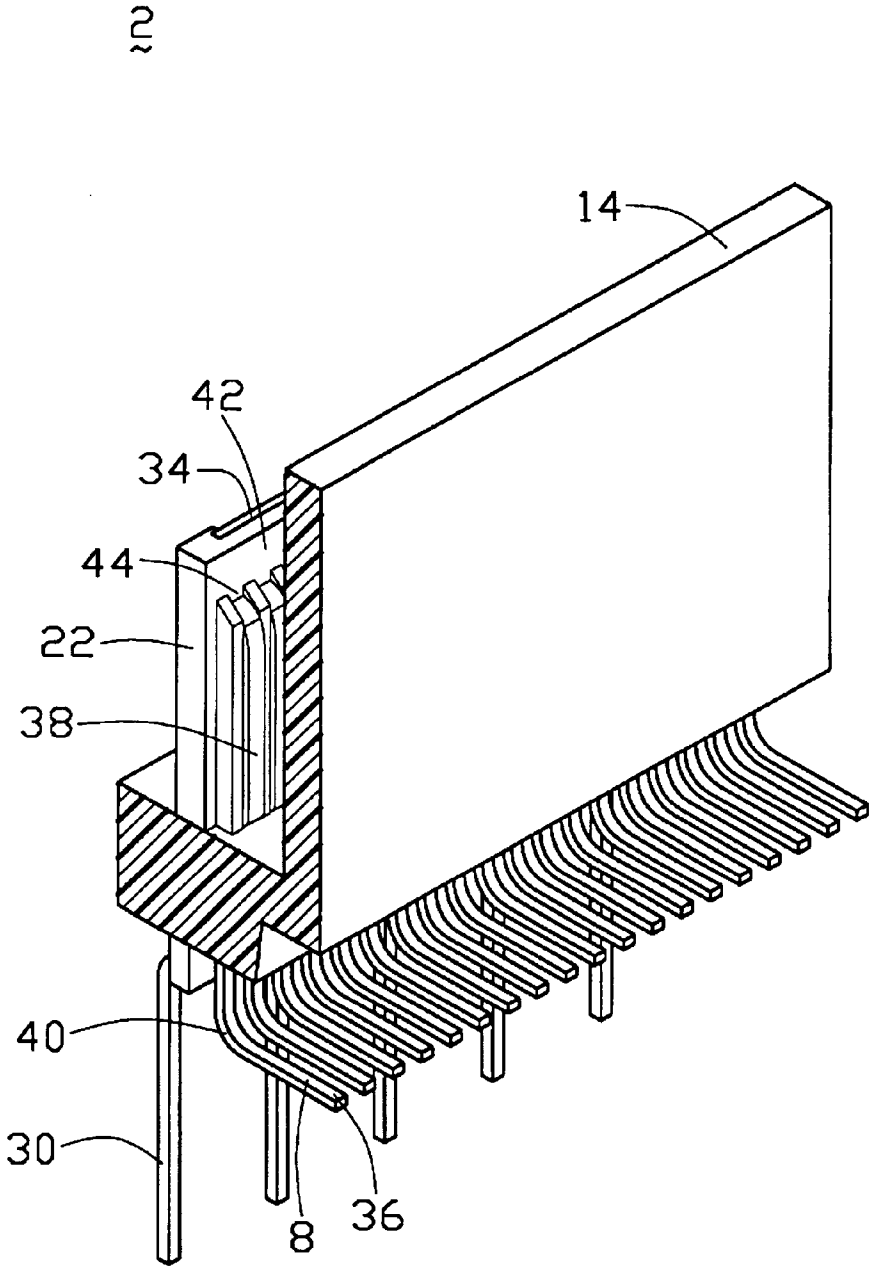


FIG. 4

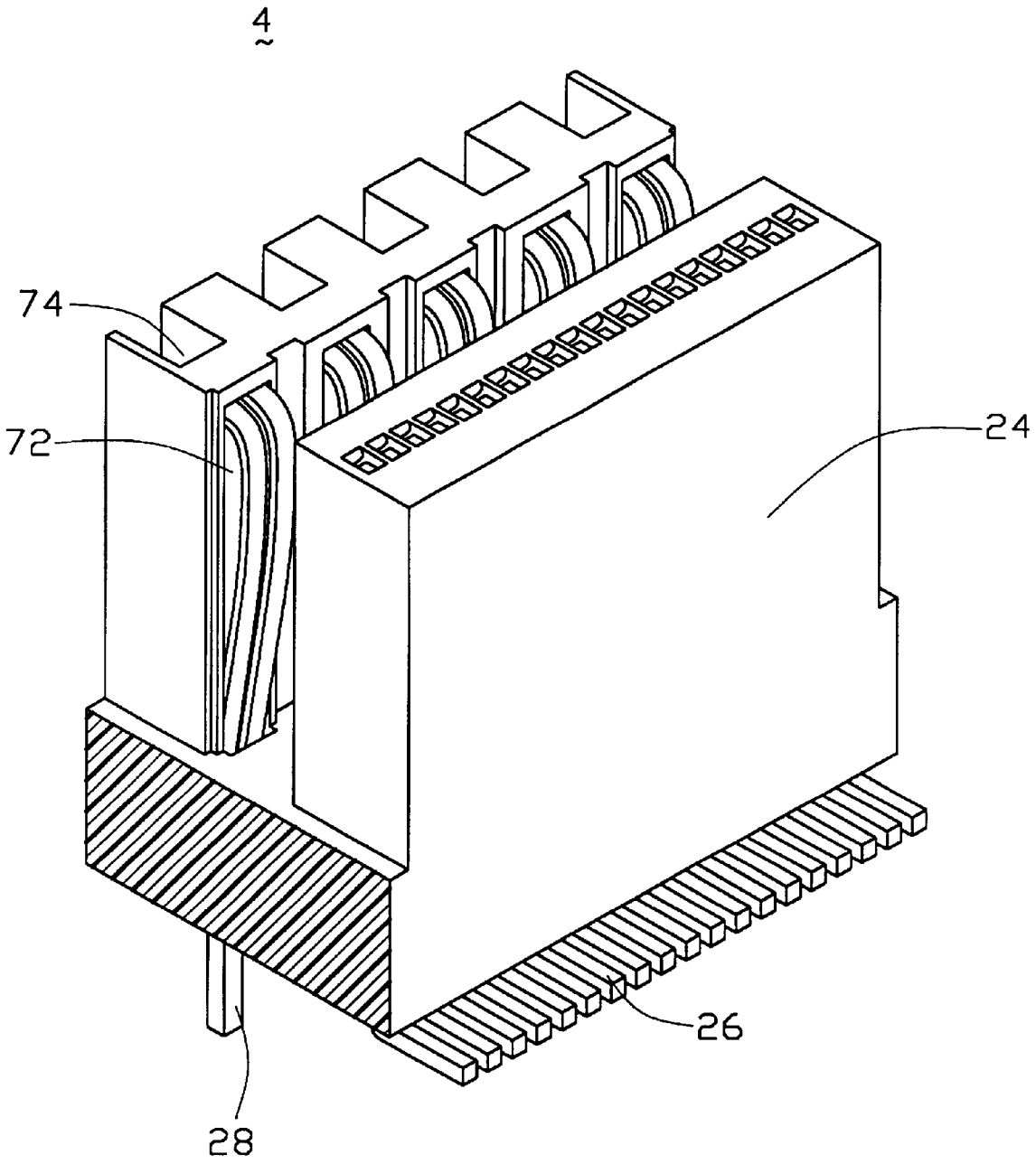


FIG. 5

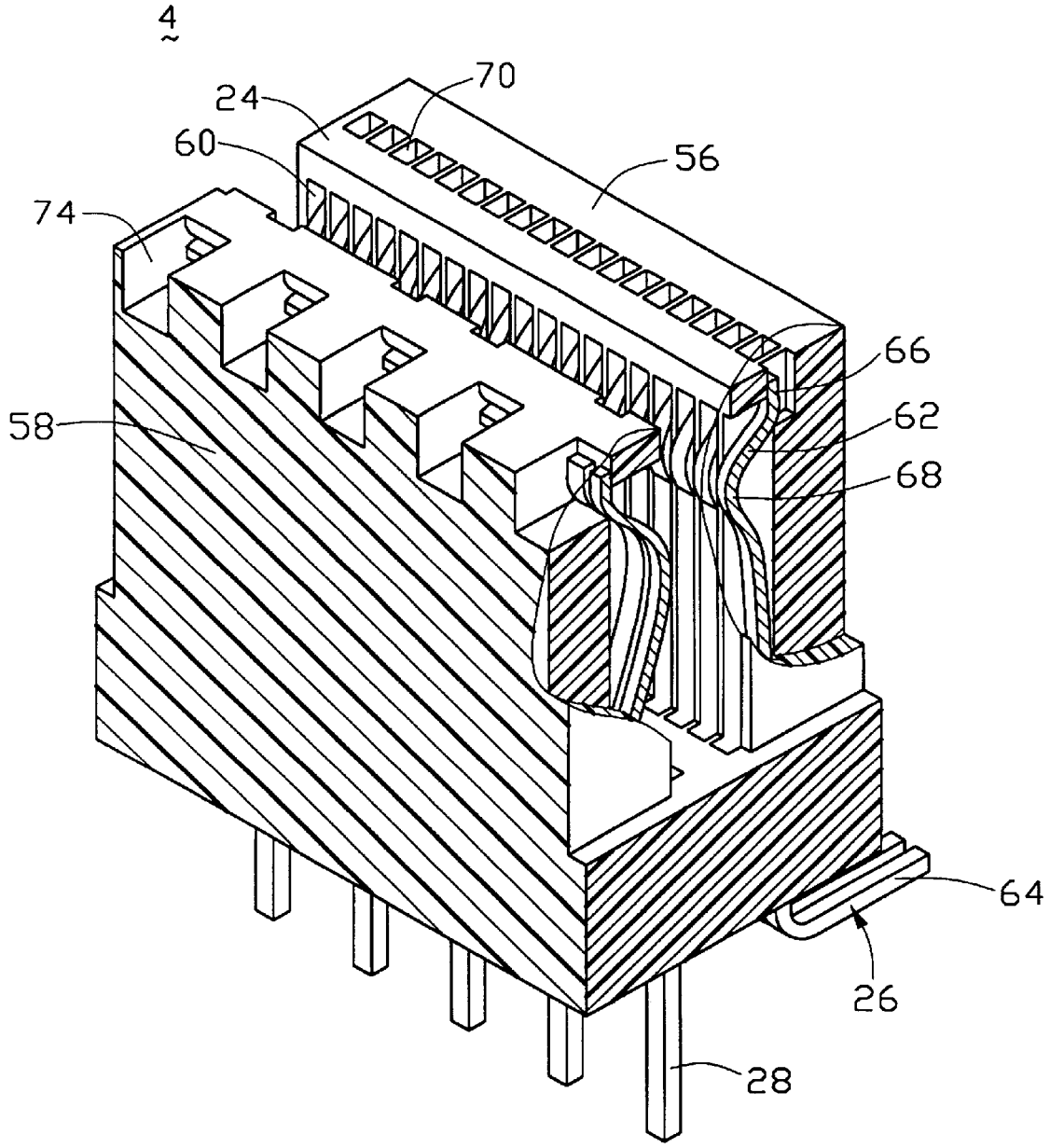


FIG. 6

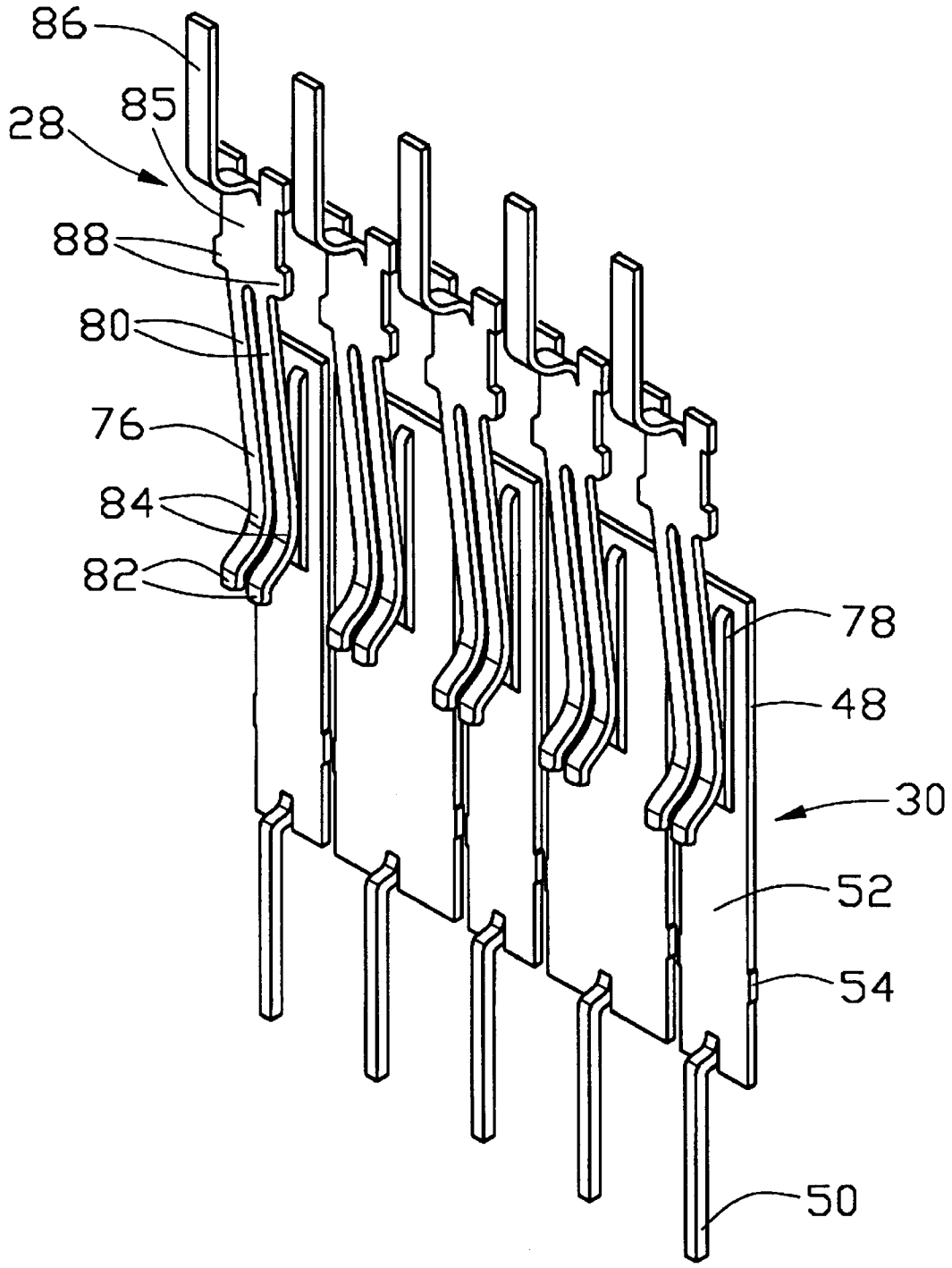


FIG. 7

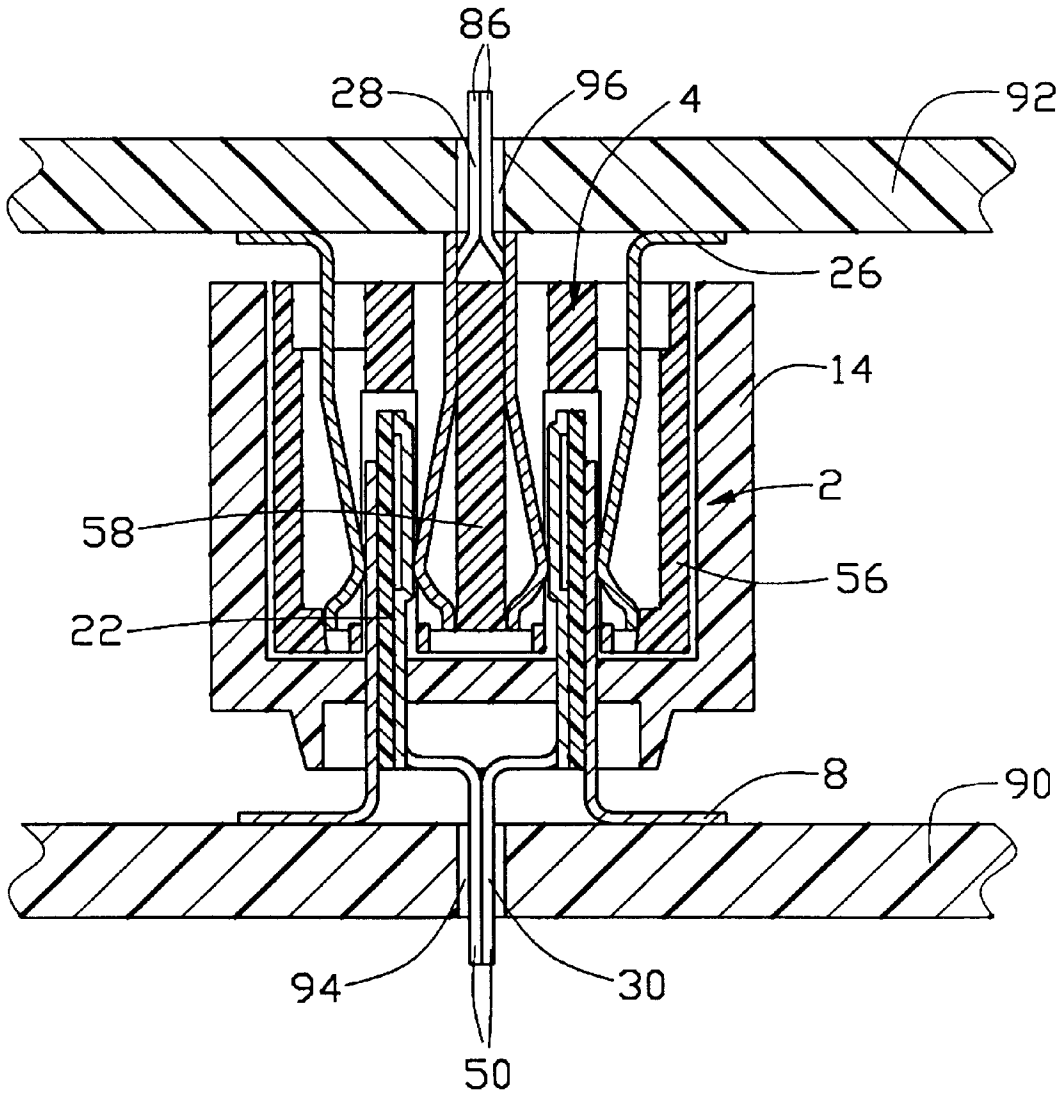


FIG. 8

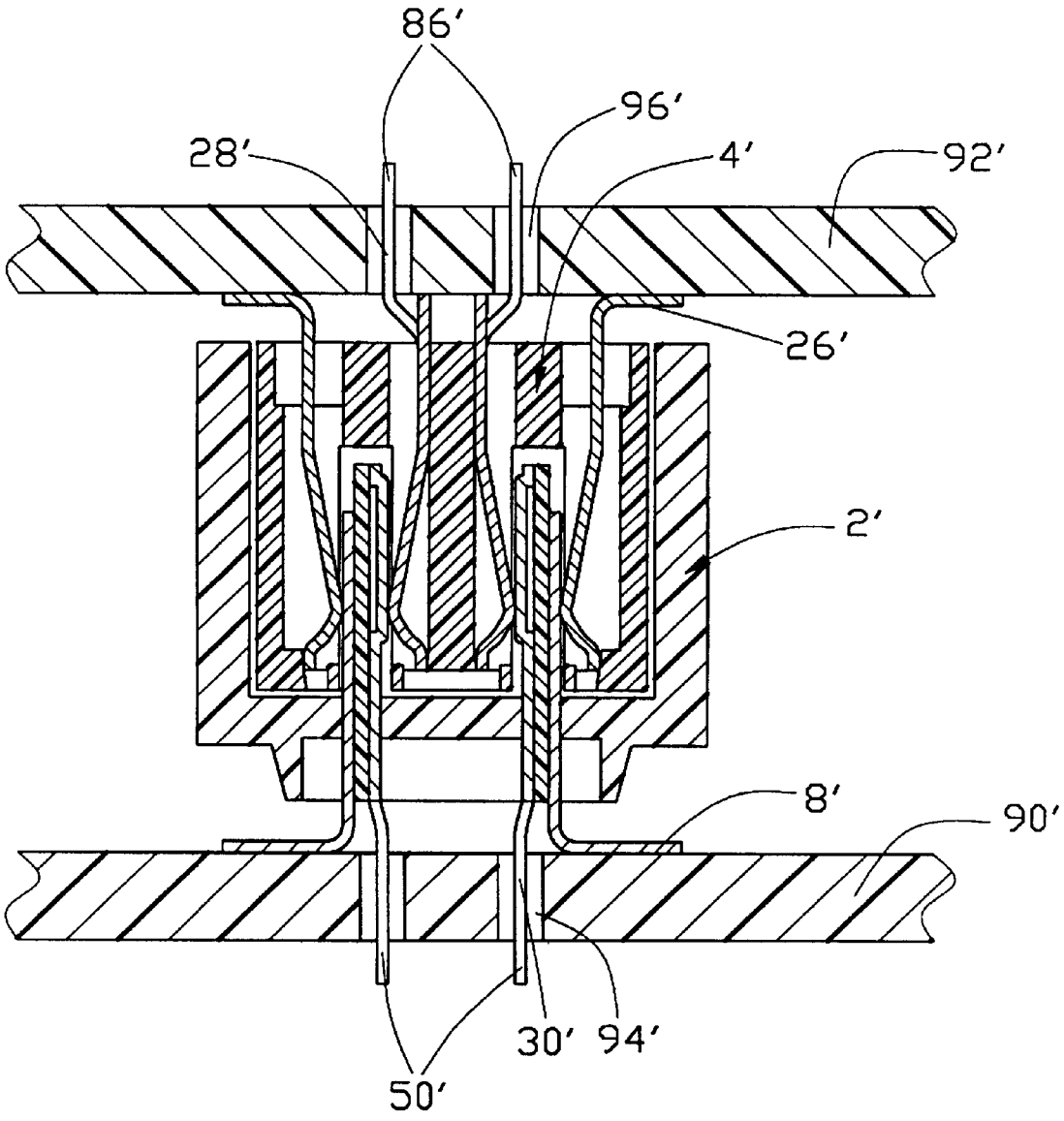


FIG. 9

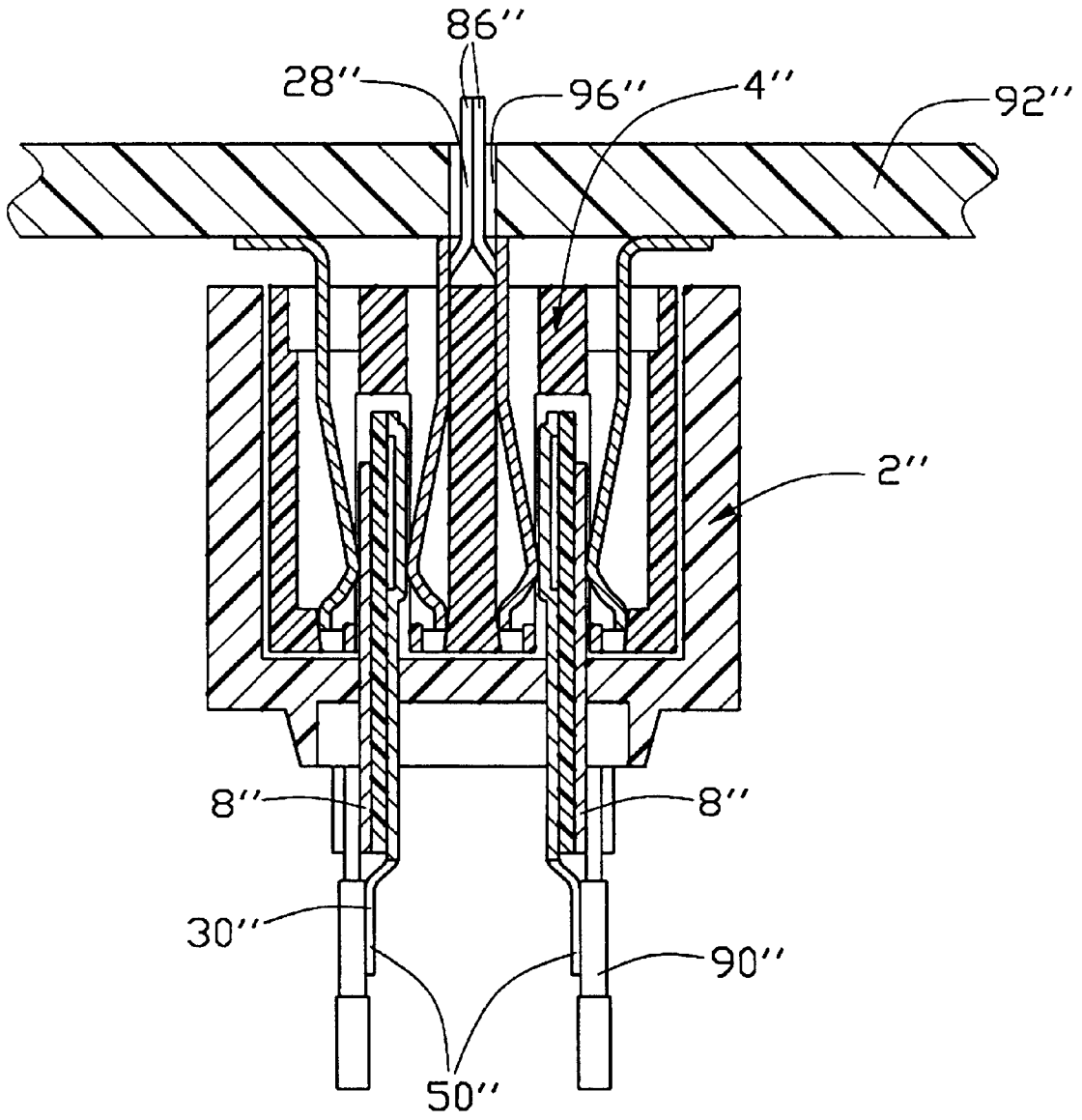


FIG. 10

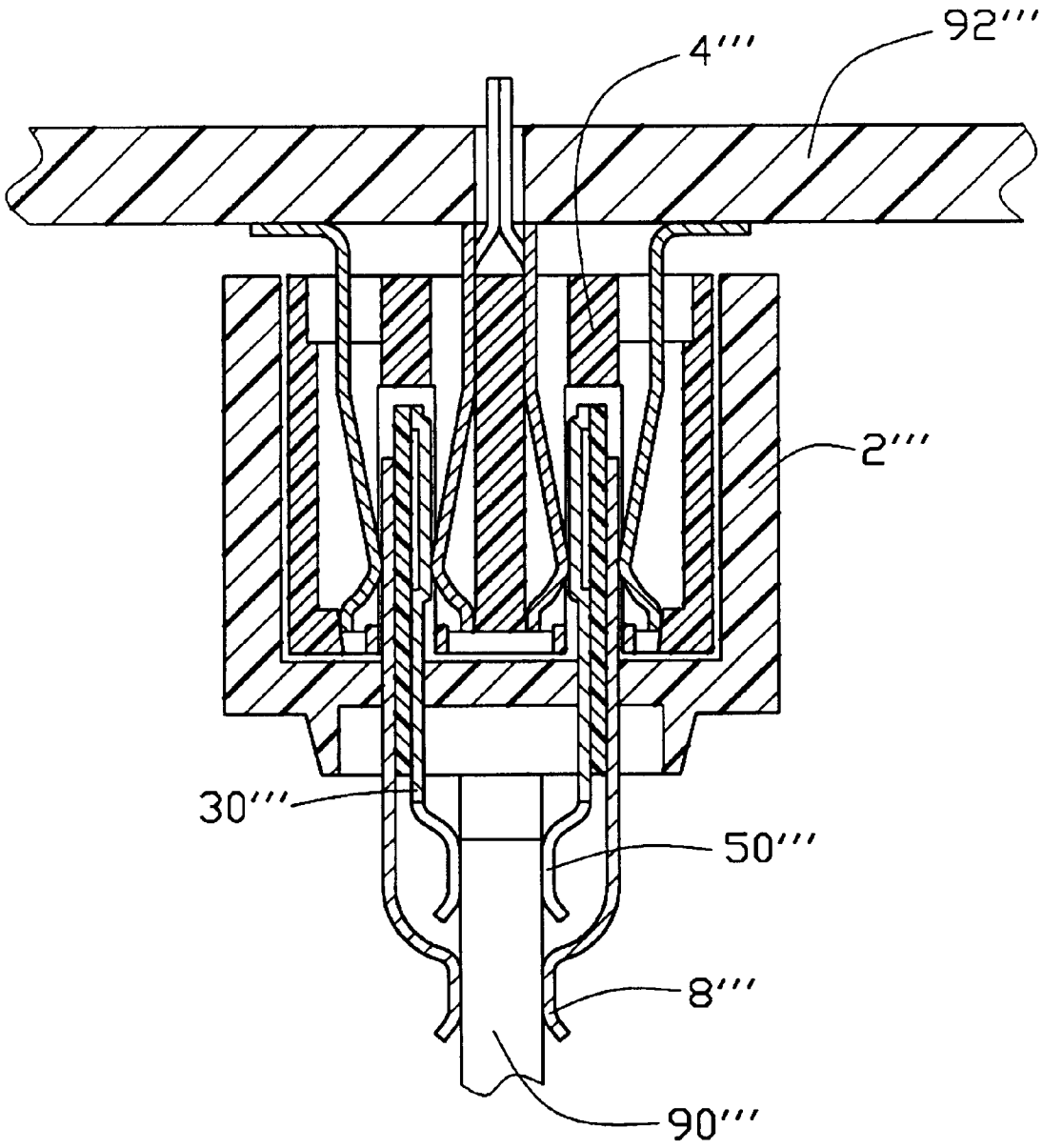


FIG. 11

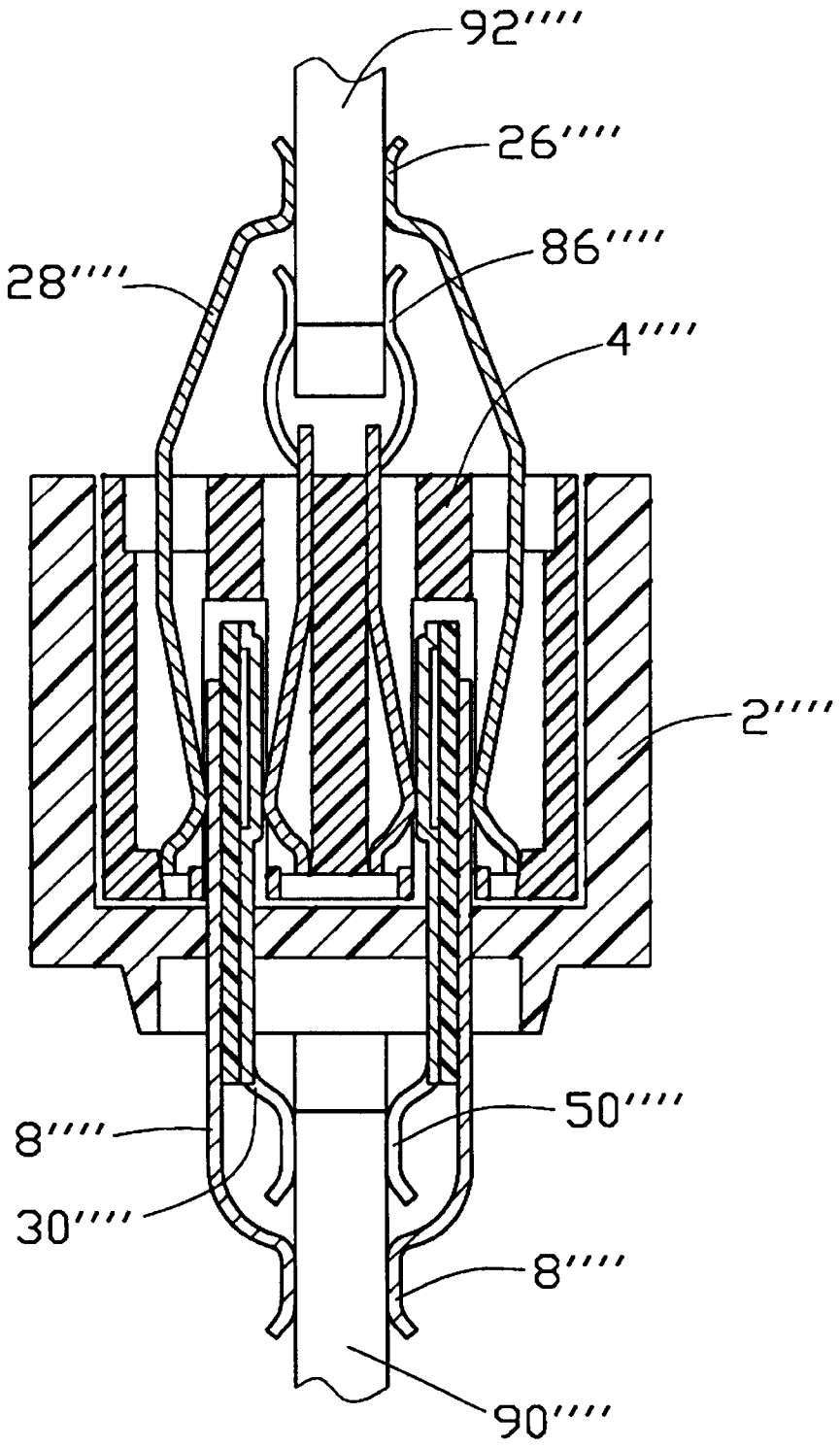


FIG. 12

ELECTRICAL CONNECTOR ASSEMBLY HAVING GROUNDING BUSES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an electrical connector assembly, and particularly to an electrical connector assembly having a plurality of grounding buses for enhancing the signal quality of high frequency signals transmitted therethrough.

2. Prior Art of the Invention

U.S. Pat. No. 5,813,871 discloses an electrical connector assembly for interconnecting two circuit boards which transmit relatively high frequency signals. The electrical connector assembly includes a receptacle connector and a mating plug connector. The plug connector includes a central elongated ground plate which has a plurality of leads along its length for engaging with a circuit board. The leads extend from each side of the ground plate at equal intervals. The plug connector further includes an outer shield that substantially surrounds the plug connector and has a plurality of leads extending from a bottom edge thereof for contacting with corresponding leads of the ground plate.

The receptacle connector includes a base and a plurality of shield plates. The base has a cavity defined therein for receiving a mating portion of the plug connector and a central portion extending into the cavity with a slot defined therein running the entire length of the central portion. When the plug connector and the receptacle connector are fully mated, the elongated ground plate extends well into the slot and is in electrical engagement with each of the shield plates. This provides a relatively short ground path from a first circuit board positioning the receptacle connector to a second circuit board positioning the plug connector, thereby significantly reducing crosstalk between two adjacent signal contacts of the electrical connector assembly.

However, this design provides only one ground plate in the plug connector which only provides a grounding function. Further, once the planarity of the ground plate is lost, a reliable engagement between the ground plate of the plug connector and the shield plates of the receptacle connector cannot be achieved. Hence, an improved electrical connector assembly is required to overcome the disadvantages of the prior art.

BRIEF SUMMARY OF THE INVENTION

A first object of the present invention is to provide an electrical connector assembly having a plurality of grounding buses each having two engaging ribs for achieving reliable grounding performance.

A second object of the present invention is to provide an electrical connector assembly having a plurality of ground buses which can be used for either grounding or power transmission.

To achieve the above objects, an electrical connector assembly in accordance with the present invention comprises a receptacle connector and a mating plug connector. The receptacle connector comprises an insulative housing and a plurality of signal terminals. The insulative housing further has two elongated sidewalls defining a plurality of channels for receiving corresponding signal terminals, and an internal wall between the two elongated sidewalls defining a plurality of grooves for receiving a plurality of first ground buses therein. The plug connector comprises a dielectric housing and a plurality of signal contacts. The

dielectric housing defines a base and two rows of tongues extending upward from the base. Each tongue has an outer side surface and an inner side surface. The outer side surface of the tongue defines a plurality of passageways for receiving a plurality of signal contacts which engage with the signal terminals of the receptacle connector, and the inner side surface of the tongue defines a plurality of grooves for receiving a plurality of second ground buses which engage with the first ground buses of the receptacle connector. Each first ground bus includes a mating portion consisting of two engaging ribs each having a free end section and an arcuate section, and each second ground bus includes a mating portion having two ribs for contacting corresponding two engaging ribs of the first ground bus. In assembly, the free end section of the first ground bus is released from being preloaded by the insulative housing, and the arcuate section of each engaging rib engages with a corresponding rib of the mating portion of the second ground bus thereby ensuring a reliable engagement between the first ground buses and second ground buses.

Other objects, advantages and novel features of the invention will become more apparent from the following detailed description of the present embodiment when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a mated electrical connector assembly in accordance with a first embodiment of the present invention;

FIG. **2** is a perspective view of the electrical connector assembly of FIG. **1** including a plug connector and a receptacle connector in an unmated state;

FIG. **3** is a fragmental view of the plug connector of FIG. **2**;

FIG. **4** is a view similar to FIG. **3** but viewed from a different angle;

FIG. **5** is a fragmental view of the receptacle connector of FIG. **2**;

FIG. **6** is a view similar to FIG. **5** but viewed from a different angle and with a portion cut out for illustrating the relationship between the signal terminals, the first ground buses and the housing;

FIG. **7** is a perspective view illustrating the engagement between the first ground buses and second ground buses in accordance with the present invention;

FIG. **8** is a cross-sectional view of the electrical connector assembly of FIG. **1** mated together and mounted to two different circuit boards;

FIG. **9** is a cross-sectional view of an electrical connector assembly in accordance with a second embodiment of the present invention mounted to two circuit boards;

FIG. **10** is a cross-sectional view of an electrical connector assembly in accordance with a third embodiment of the present invention;

FIG. **11** is a cross-sectional view of an electrical connector assembly in accordance with a fourth embodiment of the present invention; and

FIG. **12** is a cross-sectional view of an electrical connector assembly in accordance with a fifth embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

For facilitating understanding, like components are designated by like reference numerals throughout various

embodiments of the present invention as shown in the various drawing figures.

Referring to FIGS. **1** and **2**, an electrical connector assembly **1** in accordance with a first embodiment of the present invention comprises a plug connector **2** and a mating receptacle connector **4**. The plug connector **2** includes a dielectric housing **6** and a plurality of signal contacts **8** received in the dielectric housing **6**. The dielectric housing **6** includes a base **10**, four sidewalls **12**, **14**, **16**, **18** extending upward from the base **10** to define a receiving cavity **20** therebetween, and four tongues **22** extending upward from the base **10** into the receiving cavity **20** to engage with the mating receptacle connector **4**. The receptacle connector **4** includes an insulative housing **24** and a plurality of signal terminals **26** received in the insulative housing **24**. A plurality of first ground buses **28** and second ground buses **30** is received in the receptacle connector **4** and in the plug connector **2**, respectively.

Referring to FIGS. **3** and **4**, a plurality of passageways **44** is defined in an outer side surface **42** of each tongue **22** of the plug connector **2** to receive corresponding signal contacts **8** therein for signal transmission. Five grooves **34** having two different widths are defined in an inner side surface **46** of each tongue **22** for retaining five second ground buses **30**, also having two different widths, therein. A plurality of T-shaped ribs **32** is thus defined by the grooves **34**. Each second ground bus **30** can also be used to transmit power, and the width of each second ground bus **30** corresponds to several signal contacts **8**. In this embodiment, the two widths of second ground buses **30** are arranged in an alternating manner. Each broader second ground bus **30** can protect five signal contacts **8**, while each narrower second ground bus **30** can protect three signal contacts **8**. Each signal contact **8** includes an engaging section **38** positioned in the passageway **44**, a soldering section **36** for being soldered to a printed circuit board (PCB) **90** (FIG. **8**), and a curved middle section **40** for connecting the soldering section **36** with the engaging section **38**.

Referring to FIG. **7**, each second ground bus **30** includes a mating portion **48** for engaging with a corresponding first ground bus **28**, a soldering portion **50** retained in the PCB **90** (FIG. **8**), and a joint portion **52** between the mating portion **48** and the soldering portion **50**. The joint portion **52** further includes two teeth **54** respectively formed on both sides thereof. The teeth **54** engage with the T-shaped ribs **32** for retaining the second ground buses **30** in the grooves **34**. Each mating portion **48** has two ribs **78**.

Referring to FIGS. **5** and **6**, the insulative housing **24** of the receptacle connector **4** comprises two elongate sidewalls **56** (only one shown) and two lateral end walls (not labeled), together defining a cavity (not labeled) therebetween, and an internal wall **58** upwardly extending into the cavity. A plurality of channels **60** are respectively defined in the two elongate sidewalls **56** with corresponding signal terminals **26** being received therein. An opening **70** is defined at one end of each channel **60**. Each signal terminal **26** includes a mating portion **62** and a soldering section **64**. The mating portion **62** defines a free end section **66** and an arcuate section **68**. The free end section **66** engages with an inner surface of the opening **70** of the channel **60** for preloading before the arcuate sections **68** mates with the signal contact **8** of the plug connector **2**. The free end section **66** disengages from the inner surface of the opening **70** when the arcuate section **68** is mated with the signal contact **8**. By this design, breakage of the signal terminals **26** is prevented.

The internal wall **58** comprises two rows of grooves **72** (only one row is shown in FIGS. **5** and **6**) each defining a recess **74** at one end thereof. As is clearly shown in FIG. **7**, each first ground bus **28** includes a mating portion **76** including two engaging ribs **80** each having a free end section **82** and an arcuate section **84**, a soldering portion **86** for mating with a PCB **92** (FIG. **8**), and a retention portion **85** between the mating portion **76** and the soldering portion **86**. Two teeth **88** are formed on both sides of the retention portion **85**. The two teeth **88** interferentially engage with the groove **72** to retain the first ground bus **28** therein. In assembly, the free end section **82** is preloaded by the recess **74**, and the two arcuate sections **84** of the engaging ribs **80** of the mating portion **76** engage with the two ribs **78** of the corresponding second ground bus **30** of the plug connector **2**.

The signal contacts **8** of the plug connector **2**, the signal terminals **26** of the receptacle connector **4**, and the first ground buses **28** and second ground buses **30** are formed, so the reliability thereof is better than if they were stamped. The first ground buses **28** and second ground buses **30** can serve as a grounding plane and an electrical connector ground, or for electrical power transmission. First ground buses **28** and second ground buses **30** are arranged back-to-back in pairs, pairs of their soldering portions **86** and **50** engaging with signal holes **96**, **94** in the PCBs **92**, **90**. Therefore, the footprint of the electrical connector assembly on the PCBs is compatible with the prior art assembly.

Referring to FIG. **8**, in use, the plug connector **2** soldered to the PCB **90** mates with the receptacle connector **4** soldered to the PCB **92** whereby the signal contacts **8** engage with the signal terminals **26**. Thus, an electrical circuit is established between the PCBs **90** and **92** via the contacts **8** and the terminals **26**. In addition, the first ground buses **28** and second ground buses contact each other. The two rows of soldering portions **86** and **50** of the respective ground buses **28** and **30** together extend through corresponding holes **96** and **94** defined in the respective PCBs **92** and **90**.

FIG. **9** is a second embodiment of the present invention, which is similar to the first embodiment. When the plug connector **2'** mates with the receptacle connector **4'**, the first ground buses **28'** and second ground buses **30'** engage with each other. However, the two rows of the soldering portions **86'** and **50'** are respectively separated from each other and extend through the corresponding holes **96'** and **94'** defined in the PCBs **92'** and **90'**. The first and second embodiments are for use in situations where the PCBs **90** and **92** are parallel to each other.

FIG. **10** is the third embodiment of the present invention, wherein the PCB **92"** engaging with the receptacle connector **4"** is perpendicular to two PCBs **90"** which each form part of a cable assembly (not labeled) terminated to the plug connector **2"**. In this embodiment, each row of the signal contacts **8"** and the soldering portions **50"** of the second ground buses **30"** are soldered to one PCB **90"**, and the two rows of the soldering portions **86"** of the first ground buses **28"** together extend through one row of corresponding holes **96"** in the PCB **92"**.

FIG. **11** is a fourth embodiment of the present invention wherein the plug connector **2'"** is configured as a right angle connector. When the plug connector **2'"** mates with the receptacle connector **4'"**, the two rows of signal contacts **8'"** and the soldering portions **50'"** of the second ground buses **30'"** are soldered to both sides of the PCB **90'"** which connects perpendicular to the PCB **92'"**.

FIG. **12** is a fifth embodiment of the present invention. When the plug connector **2""** mates with the receptacle connector **4""**, the two rows of signal contacts **8""** and signal

terminals **26**"" engage with each other, and the soldering portions **50**"" and **86**"" of the second and first ground buses **30**"" and **28**"" are soldered to both sides of the respective PCBs **90**"" and **92**"".

It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. An electrical connector assembly comprising:

a receptacle connector having an insulative housing, a plurality of terminals and a plurality of first ground buses, each first ground bus including two engaging ribs, said insulative housing comprising two elongated sidewalls defining a plurality of channels for receiving the corresponding terminals and an internal wall between the two elongated sidewalls for receiving the plurality of first ground buses; and

a plug connector being used for mating with the receptacle connector and having a dielectric housing, a plurality of contacts and a plurality of second ground buses, each second ground bus including two ribs alignedly contacted with corresponding engaging ribs of the first ground bus, said dielectric housing comprising a base and two rows of tongues extending from the base and engaging with the two elongated sidewalls and the internal wall, each tongue having two opposite outer and inner surfaces, wherein the outer surface defines a plurality of passageways for receiving the contacts to engage with the terminals, and the inner surface forms a plurality of grooves for receiving the plurality of second ground buses to engage with the first ground buses;

wherein respective widths of the second ground buses are individually differently sized to span a range corresponding to a width of one contact or a width of more contacts.

2. The electrical connector assembly as claimed in claim **1**, wherein each ground bus can be used as a grounding plane and as an electrical ground connector or for electrical power transmission.

3. The electrical connector assembly as claimed in claim **1**, wherein the internal wall of the receptacle connector defines a plurality of grooves for receiving the plurality of first ground buses.

4. The electrical connector assembly as claimed in claim **3**, wherein the first ground bus has a mating portion, a soldering portion and two teeth located between the mating portion and the soldering portion to engage with the grooves for retaining the plurality of first ground bus in the receptacle connector.

5. The electrical connector assembly as claimed in claim **4**, wherein the two engaging ribs constitute the mating portion, each engaging rib includes a free end section and an arcuate section for mating with the second ground bus, and each groove defines a recess at one end thereof receiving and preloading the free end section.

6. The electrical connector assembly as claimed in claim **5**, wherein a plurality of T-shaped ribs is located between each two adjacent grooves of the plug connector.

7. The electrical connector assembly as claimed in claim **6**, wherein each second ground bus has a mating portion, a soldering portion and a joint portion located between the mating portion and the soldering portion, the joint portion having two teeth on both sides thereof to engage with said T-shaped rib.

8. The electrical connector assembly as claimed in claim **1**, wherein each terminal has a free end section, and each channel of the receptacle connector defines an opening for preloading the free end section.

9. An electrical connector assembly comprising:

an elongated receptacle connector having an insulative housing, a plurality of terminals and a plurality of first ground buses received in the insulative housing, said terminals being arranged in at least two rows along the elongated direction, said first ground buses located between the terminals;

an elongated plug connector having a dielectric housing, a plurality of contacts and a plurality of second ground buses received in the dielectric housing, said contacts being arranged in at least two rows along the elongated direction, said second ground buses located between the contacts;

wherein when the plug connector mates with the receptacle connector, the terminals engage with the contacts for signal transferring, and the first ground buses and second ground buses respectively engage for grounding or power; and

wherein each first ground buses defines two ribs alignedly contacted with corresponding ribs of each second ground buses, and respective widths of the second ground buses are individually differently sized to span a range corresponding to a width of one contact or a width of more contacts.

10. The electrical connector assembly as claimed in claim **9**, wherein each rib of each first ground bus includes a free end section for preloading with the insulative housing and an arcuate section for engaging.

11. The electrical connector assembly as claimed in claim **9**, wherein all the terminals are preloaded to prevent damage during mating.

12. The electrical connector assembly as claimed in claim **9**, wherein the width of the first ground buses and second ground buses can be changed as required.

13. An electrical connector assembly comprising:

a plug connector comprising:

a dielectric housing having a base, a sidewall and a tongue both projecting from the base and defining a space therebetween, the tongue having opposite first and second faces;

a ground bus fixed to the first face, the ground bus comprising at least a pair of ribs projecting therefrom in a direction away from the first face; and

a plurality of signal contacts fixed to the second face and facing the sidewall; and

a receptacle connector mating with the plug connector, comprising:

an insulative housing having a bottom wall, first and second sidewalls projecting from the bottom wall, wherein the first sidewall of the insulative housing of the receptacle connector being fitted within the space defined between the sidewall and tongue of the dielectric housing of the plug connector;

a plurality of signal terminals received in the first wall of the housing of the receptacle connector and in electrical connection with corresponding signal contacts of the plug connector; and

a ground bus received in the second wall of the insulative housing of the receptacle connector, the

ground bus of the receptacle connector comprising two ribs alignedly contacted with corresponding ribs of plug connector, and being in electrical engagement with the pair of ribs of the ground bus of the receptacle connector;

wherein a width of the ground bus of the plug connector spans a range corresponding to a width of one contact or a width of more contacts.

14. An electrical connector assembly comprising:

a receptacle connector including an insulative housing with a pair of sidewalls and an internal wall between said pair of sidewalls;

two rows of terminals oppositely disposed on opposite inner surfaces of the pair of sidewalls, respectively;

two rows of first ground buses oppositely disposed on two opposite surfaces of the internal wall;

a plug connector including a dielectric housing with a pair of spaced tongues, said pair of tongues defining an external dimension which allows said pair of tongues to be snugly received between said pair of sidewalls of the receptacle connector, and further defining an internal dimension which allows the internal wall of the receptacle connector to be snugly received between said pair of tongues;

two rows of contacts disposed on opposite outer surfaces of said pair of tongues, and respectively engaged with the corresponding terminals;

two rows of second ground buses disposed on opposite inner surfaces of said pair of tongues, and respectively engaged with the corresponding first ground buses; wherein

tails of said two rows of first ground buses are joined as one, and tails of said two rows of second ground buses are also joined as one aligned with said one of the first ground buses.

* * * * *